## Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Description</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>06/07/2010</td>
<td>Draft</td>
<td>Created the external business requirements document based on internal finalized business requirements</td>
<td>CAISO</td>
</tr>
<tr>
<td>06/29/2010</td>
<td>1.1</td>
<td>Updated document after stakeholder review</td>
<td>CAISO</td>
</tr>
<tr>
<td>9/17/2010</td>
<td>1.2</td>
<td>Included clarifying requirements etc.</td>
<td>CAISO</td>
</tr>
<tr>
<td>9/22/2010</td>
<td>1.3</td>
<td>Legal Review</td>
<td>CAISO</td>
</tr>
<tr>
<td>9/23/2010</td>
<td>1.4</td>
<td>Review for consistency</td>
<td>CAISO</td>
</tr>
<tr>
<td>9/01/2011</td>
<td>1.5</td>
<td>Bid generation requirements (BRQ018-020). Modified existing requirements and narratives to accept new bid generation requirements</td>
<td>CAISO</td>
</tr>
</tbody>
</table>
Table of Contents

1. INTRODUCTION ...................................................................................................................... 4
   1.1 PURPOSE .............................................................................................................................. 4
   1.2 REFERENCES ......................................................................................................................... 4

2. DETAILS OF BUSINESS NEED/PROBLEM .............................................................................. 5
   2.1 DESCRIPTION ....................................................................................................................... 5

3. BUSINESS PROCESS IMPACTS ............................................................................................. 6
   3.1 HIGH LEVEL BUSINESS PROCESS .................................................................................... 6
       3.1.1 Description .................................................................................................................... 6

4. BUSINESS REQUIREMENTS .................................................................................................... 7
   4.1 BUSINESS PROCESS: 72 HOUR RUC ................................................................................ 7
       4.1.1 Business Requirements ............................................................................................... 8
   4.2 BUSINESS PROCESS: OTHER PROCESSES ................................................................. 11
       4.2.1 Business Requirements ............................................................................................. 11

Disclaimer
All information contained in this draft Business Requirements Specification (BRS) as provided by the California Independent System Operator Corporation (ISO) is prepared for discussion and information purposes only. The draft BRS is provided “as is” without representation or warranty of any kind, including, without limitation, a representation or warranty as to accuracy, completeness, or appropriateness for any particular purpose. The draft BRS shall be revised as the development and review of the business requirements progresses. The ISO assumes no responsibility for the consequences of any errors or omissions. The ISO may revise or withdraw all or part of this information at any time at its discretion without notice.
1. Introduction

1.1 Purpose

The ISO intends to extend the Residual Unit Commitment (RUC) process time horizon to a configurable maximum of 72 hour unit commitment rather than the current fixed single 24 hour time horizon. The extension will affect the time horizon for the run, but will retain the 24 hour financially binding commitment for the RUC process. Extending the RUC time horizon to a configurable 72 hour period allows the optimization solution to evaluate if it is economic to keep a resource online during off-peak hours versus cycling the resource off based on the next day’s load forecast conditions. The more complete and favorable solution is to extend the Integrated Forward Market time horizon using a 72 hour process, as well as possible modifications to the financially binding commitment time periods (i.e., multi-day commitment). However, at this time, the ISO is only implementing the incremental improvement given that a more robust improvement requires more substantial market rule changes regarding bid submission and bidding behavior and related software enhancements.

72 Hour RUC is an extension of the RUC unit commitment functionality spanning over a configurable 72 hour period including the applicable trading day for the specific RUC run. 72 Hour RUC aims to provide two market enhancements: 1) Increase grid reliability reducing the amount of uneconomic cycling of resources; 2) Increase economic efficiency by reducing the commitment costs caused by additional start-up cost due to uneconomic cycling. This requirement document describes this short term approach. This process also requires some modifications of the existing Extremely Long Commitment (ELC) process as discussed further below.

In addition to the RUC enhancement, the ISO is adopting a process enhancement (“initial conditions setting”) that will mitigate the effect of cycling by providing operators necessary information regarding a resource’s intent to stay online during the cycling period so that the ISO operators may consider such intent in setting the initial conditions for the next Day-Ahead Market. Additional information regarding this effort is available at http://www.caiso.com/27ab/27abd1ed37660.pdf and in the proposed changes currently proposed to the Business Practice Manual.

1.2 References

All references represent external requirements documents or stakeholder requests developed and submitted by the Business Units.


2. Details of Business Need/Problem

2.1 Description

The Day-Ahead Market’s (DAM) commitment window is not capable of effectively utilizing Long Start and Extremely Long Start Units in day-ahead commitment and for mitigating exceptional dispatch in the Real-Time Market (RTM). The current DAM implementation begins committing units less than 24 hours before the applicable trading day. The DAM does not take full advantage of Long Start and Extremely Long Start Units that are committed and dispatched toward the end of a trade date or the beginning of the next trade date. These generation resources have startup times greater than four and 18 hours respectively and are currently susceptible to cycling instead of commitment to provide long-term generation. Modifying the manual Extremely Long Start Commitment (ELC) processes with RUC functionality can incorporate reliable and less expensive generation, and can help to mitigate exceptional dispatch in RTM. Similarly the long start units, i.e., units with startup time less than 18 hours but longer than four hours can be also susceptible to uneconomic cycling.

72 Hour RUC aims to solve these two commitment issues for both extra long start units and long start units by providing a larger commitment window while using existing vendor functionality for its implementation. 72 Hour RUC will extend the RUC commitment process that utilizes Security Constrained Unit Commitment (SCUC) to span a configurable 72 hours.
3. Business Process Impacts

3.1 High Level Business Process

3.1.1 Description

In current production, RUC may commit additional capacity committed by the preceding IFM run. RUC determines the gap in demand between the CAISO Forecast of CAISO Demand (CFCD) and the IFM scheduled load. Based on this forecasted load, RUC uses the Security Constrained Unit Commitment (SCUC) algorithm to extend existing commitments, commit new generation resources, and to honor transmission constraints, outages, etc. Currently the RUC process commits Short Start and Long Start Units for the next 24 hour time horizon. Long Start Units need between five and 18 hours to start up and synchronize to the grid. The ISO will only issue RUC Start-Up Instructions to resources committed in RUC that must receive a Start-Up Instruction in the Day-Ahead in order to be available to meet real-time Demand.

In current production, ELC is a supply commitment process through which the ISO operators may manually issue startup instructions to Extremely Long Start Generators (ELS). ELS units have a startup horizon greater than 18 hours. ISO operators can manually issue startup instructions based on submitted bids and Good Utility Practices for the next 48 hour (or longer) time horizon by placing a phone call to the unit's Scheduling Coordinator. Extremely Long Start Generators are committed in the ELC process up to their minimum load.

72 Hour RUC is achieved by extending the RUC to look ahead over a configurable default 72 hour period (TD+1, TD+2, TD+3). This will allow:

1. If an ELS unit (i.e., units with startup times greater than 18 hours) is committed in the second or third trading day (TD+2, TD+3), 72 Hour RUC will provide binding commitment decisions and commitment instructions for the second and/or third trade days;
2. If an ELS unit is committed in the second trading day (TD+2) and does not meet the minimum up time, 72 Hour RUC will ensure the initial condition is set to be binding (i.e., ON) at the end of the trading day;
3. If a unit that is between extra long start and short start time frames (i.e., units with startup times shorter than 18 hours and longer than 4 hours) is committed for the last four hours of the trading day and is still on at the end of the day, 72 Hour RUC will ensure the initial condition is set as binding (ON) at the end of first trading day.
4. ISO operators will be able to view (via a GUI) Long Start and Extra Long Start Units’ commitment decisions on TD+2 and initial conditions at the end of TD+2 to assist in future commitment decisions.

In Case 1, the commitment decision in the second trading day is binding but the energy and ancillary services bids in the subsequent day-ahead run for the second trading day can still be used to determine the optimal schedule and capacity.

In both Case 2 and 3, the commitment decision for the second trading day is not binding, only the initial conditions are binding. This will allow the subsequent Day-Ahead Market to keep the unit On at the beginning of the second trading day. However, the commitment decision, energy and ancillary service, are all again optimally determined by the subsequent Day-Ahead Market run for the second trading day.
4. Business Requirements

4.1 Business Process: 72 Hour RUC

72 Hour RUC shall be based on a simultaneous run of 3-24-hour days for the 72 hour time horizon (configurable), utilizing SCUC optimization to provide startup and commit ELS units in order to meet CFCD. This 72-hour simultaneous (i.e. "3-day-in-one-run") RUC execution shall commit and provide startup instructions for Extremely Long Start units committed in the second and third trade days and will provide the initial conditions to reflect the ‘On’ status of the ELS and Long Start Units committed at the end of the first and second trading days.

The 72 Hour RUC process utilizes distinct sets of DAM bids for the first trade date in the process (TD+1) submitted by market participants through SIBR. For TD+2, TD+3, 72 Hour RUC shall utilize historical energy bids and self schedules from the previous 7 days to commit resources. 72 Hour RUC shall allow the market operators to pick any trading day within the 7-day history to copy that trade day’s entire energy bid/self schedules into either TD+2 or TD+3 as they deem appropriate.

For ELS resources, 72 Hour RUC and the ELC Process shall use market participant submitted bids for TD+1 for committing resources in TD+2 and TD+3.

The initial condition (whether the generation unit’s state is on/off) plays a pivotal role in the next day’s IFM and the next 72 Hour RUC unit commitment. The initial condition of the unit at the end of commitment in TD+1 must be retained and passed to the next days’ TD+1 Day-Ahead Market run, thus locking the initial condition. Also the binding commitment decisions for ELS units need to be passed to the TD+2 Day-Ahead Run. From the 72 Hour RUC process, TD+2’s binding commitment decisions for ELS resources shall not be passed to downstream processes. The only communication to down-stream is the startup instruction for the ELS resource as the same logic in production. The normal Day-Ahead Market run for the next day’s TD+1 will retain the commitment decision for the ELS resources and communicate those decisions to down-stream as normal Day-Ahead ISO commitment decision. This is to avoid any down-stream impacts.

The energy schedule determined in TD+2 and TD+3 in 72 Hour RUC run shall be kept non-binding. Ancillary services (AS) shall not be procured for TD+2, TD+3.

The 72 Hour RUC process is optional and may be initiated by CAISO operators on an as-needed basis in accordance with Good Utility Practices.

The 72 Hour RUC execution is set as a 72 hour default and will be executed for 1, 2, or 3 days, however the time range shall be configurable between 1 and 7 days. The process shall take into consideration Daylight Savings Time, and will shift execution accordingly. The process shall have an execution horizon of no more than 73 hours during a 3 day time horizon.

72 Hour RUC shall have the capacity to manually increase or decrease the CAISO Forecast for CAISO Demand (CFCD) for TD+2 and TD+3 as deemed necessary. This is to accommodate the lack of Ancillary Service procurement in those two trade days to make the commitment decision more viable.
4.1.1 Business Requirements

The following business rules are described using the three day – 72 hour commitment time frame to describe the concept. From a requirement perspective, all implementations shall be built for more than three day commitments.

<table>
<thead>
<tr>
<th>ID#</th>
<th>Business Feature</th>
<th>Requirement Type</th>
<th>Application(s) Impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>72RUC-BRQ001</td>
<td>Before running 72 hours RUC and for Non-ELS Resources, DAM application shall allow operators to use the historical energy bids from the previous 7 days as bids for TD+2, TD+3. This functionality shall also allow TD+2 and TD+3 to be copied from different historical trade days. For ELS Resources, the DAM application shall copy submitted bids for TD+1 as bids for TD+2, TD+3.</td>
<td>Core</td>
<td>DAM</td>
</tr>
<tr>
<td>72RUC-BRQ002</td>
<td>In the same manner as in production, the 72 Hour RUC Process shall continue to use one days' Day-Ahead bids sent by SIBR for the relevant one trade day in the horizon. RUC and optionally energy bids shall be utilized based on configuration parameters. For TD+1, TD+2 only energy bids shall be utilized.</td>
<td>Core</td>
<td>DAM</td>
</tr>
</tbody>
</table>
| 72RUC-BRQ003 | For extra long start units committed in TD+2 and TD+3, 72 Hour RUC must do the following,  
1. Communicate to send the binding ISO commitment after opportunity for review by operators along with other startup instructions that it decides for TD+2 or TD+3 using existing web services if the startup time is longer than the appropriate horizon.  
2. Save the binding commitment decisions and pass them to the Day-Ahead run for TD+2 and TD+3 at TD+1. This happens within the Day-Ahead system.  
Note: Except the binding startup instruction, all other commitment decisions for TD+2 and TD+3 shall NOT be communicated down-stream. The Day-Ahead run for TD+2 and TD+3 at TD+1 will do that as a normal Day-Ahead process. | Core             | DAM, CMRI               |
<table>
<thead>
<tr>
<th>ID#</th>
<th>Business Feature</th>
<th>Requirement Type</th>
<th>Application(s) Impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>72RUC-BRQ004</td>
<td>For extra long start units and long start units that are committed in the last four hours of the TD+1, 72 Hour RUC needs to be able to set the initial condition of the end of TD+1 to ON. The commitment decisions for those four hours shall be binding. Also these initial conditions need to be passed to the Day-Ahead run for TD+2 at TD+1 and for TD+3 at TD+2. This happens within the Day-Ahead system. For the long start units that are committed in the last four hours of the TD+2, 72 Hour RUC needs to be able to set the initial condition of the end of TD+2 to be ON for those resources. The initial condition at the end of TD+2 and the commitment decisions on TD+2 need to be made available through GUI for operators to help them make future commitment decisions. Note: There is no need to communicate these initial conditions and commitment decisions to down-stream systems.</td>
<td>Core</td>
<td>DAM</td>
</tr>
</tbody>
</table>
### External Business Requirements Specification

**ID#** | **Business Feature**                                                                                                                                                                                                 | **Requirement Type** | **Application(s) Impacted** |
---|---|---|---|
72RUC-BRQ005 | The Day-Ahead run for TD+2 at TD+1 and for TD+3 at TD+2 shall do the following,  
1. For the binding commitment decisions for extra long start units that are committed by the previous 72 Hour RUC, it shall retain those decisions;  
2. For the initial conditions that are passed by the previous 72 Hour RUC, it shall recognize the initial ON status for those resources;  
3. For Non-ELC Resources, 72 Hour RUC shall utilize 7-day historical energy bids that market operators decide to use for TD+2, TD+3 for its execution. For ELC Resources, 72 Hour RUC shall utilize submitted bids for TD+1, TD+2, and for TD+3. All processes shall communicate to down-stream systems using the exact same mechanism before 72 Hour RUC is introduced;  
4. Specifically in the case of binding commitment decisions for extra long start units, it shall communicate to down-stream systems the binding commitment decisions in the exact same manner as if those decisions were made in the current Day-Ahead run.  
5. Specifically in the case of binding commitment decisions for extra long start units, it shall communicate to down-stream systems the binding commitment decisions in the exact same manner as if those decisions were made in the current Day-Ahead run.  
Note: Item 5 is the key to avoid a down-stream impact, especially in settlement area. | Core | DAM |
72RUC-BRQ006 | The 72 Hour RUC optimization window shall be defaulted at 72 hours and shall be executed between 1, 2, or 3 days. The commitment window shall be configured anywhere between 1 day to 7 days. Startup Costs shall be considered in the configurable optimization horizon (1 to 7 days). | Core | DAM |
72RUC-BRQ007 | Operators shall have functionality to pick energy bids and self schedules from the previous (historic) 7 trade days for making commitment decisions in TD+2, TD+3. | Core | DAM |
72RUC-BRQ008 | 72 Hour RUC shall have the capacity to manually increase or decrease the California Forecast for California Demand (CFCD) for TD+2 and TD+3 as deemed necessary. | Core | DAM |
4.2 Business Process: Other Processes

4.2.1 Business Requirements

The Following requirements shall exist in production already. They are listed here for review and verification.

<table>
<thead>
<tr>
<th>ID#</th>
<th>Business Feature</th>
<th>Requirement Type</th>
<th>Application(s) Impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>72RUC-BRQ009</td>
<td>As in current production, CMRI shall continue to receive the binding commitment instructions for the extra long start units and display in existing reports. Note: Those startup instructions are sent to CMRI in production. The differences are that, those startup instructions are decided manually in the day-ahead application.</td>
<td>Core</td>
<td>CMRI</td>
</tr>
</tbody>
</table>
72 Hour RUC

External Business Requirements Specification

<table>
<thead>
<tr>
<th>ID#</th>
<th>Business Feature</th>
<th>Requirement Type</th>
<th>Application(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72RUC-BRQ010</td>
<td>The process shall take into consideration Daylight Savings Time, and will shift execution accordingly. The process shall have an execution horizon of no more than 73 hours during a 3 day time horizon.</td>
<td>Core</td>
<td>DAM</td>
</tr>
</tbody>
</table>
| 72RUC-BRQ011 | With the proposed enhancement, the Day ahead (DA) market pre-processes shall set a unit’s initial condition to “online” for next DA market run if all the following conditions are true:  
A. The unit was offered for economic-commitment in DAM (TD-1) for hours that it was not economically committed in IFM.  
B. The unit is economically committed for some hours of TD-1 in the IFM or RUC, but is not committed through the end of TD-1.  
C. By one hour prior to the close of the Day Ahead Market (DAM) for TD, at 09:00 on TD-1, the unit has self-scheduled energy (presumably, but not necessarily at P_min) submitted in the RTM for TD-1 for each of the remaining hours after the last economically-committed hour in the DAM for TD-1. Note: There can be self-commitment hours in the DAM for TD-1 after that last economically committed hour, but condition C counts starting the last economic committed hour.  
D. No Over-generation condition is anticipated for any hours in TD-1. | Core             | IFM             |
| 72RUC-BRQ012 | The initial MW of every unit shall only be set to its corresponding Pmin. If a unit is self-scheduled at a MW higher than its Pmin, the higher self-scheduled MW shall be ignored. | Core             | IFM             |
| 72RUC-BRQ013 | If there are no bids in the previous 7 days (in case of maintenance, etc.), the process shall utilize the bids submitted in the current market day for use in 72 Hour RUC. The ISO may use the bids submitted in the current market for the 72 hour RUC process regardless of maintenance for previous days. | Core             | IFM             |
| 72RUC-BRQ014 | RUC will continue to procure RUC capacity and RUC awards for the Trade Date (TD) but not for TD+1, TD+2.                                                                                                                                                     | Core             | IFM             |
| 72RUC-BRQ015 | RUC will not procure any additional Ancillary Services for the Trade Date (TD), nor for TD+1, TD+2.                                                                                                                                                         | Core             | IFM             |

1 Rules BRQ011 and BRQ012 shall have been implemented by a CAISO effort under “initial condition” already before multi-day RUC. These two rules are here to ensure consistency in further improvement of the day-ahead commitment decision.
<table>
<thead>
<tr>
<th>ID#</th>
<th>Business Feature</th>
<th>Requirement Type</th>
<th>Application(s) Impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>72RUC-BRQ016</td>
<td>ELS Resources shall utilize the Trade Date’s (TD) submitted bids for evaluating the commitment of ELS resources in TD+1, TD+2. ELS Resources that do not submit bids shall not be evaluated for TD+1, TD+2 in 72 Hour RUC.</td>
<td>Core</td>
<td>IFM</td>
</tr>
<tr>
<td>72RUC-BRQ017</td>
<td>72 Hour RUC produces RUC Awards for the Trade Date (TD) and binding commitments for TD, TD+1, and TD+2. The commitment is binding if the relevant inter-temporal constraints prevent its reevaluation in the next day’s DAM run.</td>
<td>Core</td>
<td>IFM</td>
</tr>
<tr>
<td>72RUC-BRQ018</td>
<td>The Master File Transfer script shall include the applicable registry Start Date for each Resource. This date is the latest day when registry data has been modified for each Resource. The Registry Start Date shall be used in the SIBR MD-DAM Bid Generation rules to prevent older historical Clean Bids from being copied into the Multi-Day Bid for days after the current Trading Day because the Master File registry changes may have rendered these bids invalid.</td>
<td>Core</td>
<td>MF, SIBR</td>
</tr>
<tr>
<td>72RUC-BRQ019</td>
<td>The Market Application Input and Output user interfaces shall be updated based on the requirements captured in the 72 Hour RUC User Interface Use Case Document.</td>
<td>Core</td>
<td>IFM/RTM User Interface</td>
</tr>
<tr>
<td>72RUC-BRQ020</td>
<td>The Master File Transfer Script shall include an EX_LONG_SRTT_FF flag for each resource.</td>
<td>Core</td>
<td>MF</td>
</tr>
</tbody>
</table>